ENVIRONMENTAL ASSESSMENT FOR THE PROHIBITION OF CERTAIN TWO-STROKE POWERED WATERCRAFT

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Tahoe Regional Planning Agency

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1.1 Introduction

On June 25, 1997, the Governing Board of the Tahoe Regional Planning Agency (TRPA) adopted Ordinance 97-12. The relevant portion of this ordinance prohibits the "discharge of unburned fuel and oil from the operation of watercraft propelled by carbureted two-stroke engines" commencing June 1, 1999. This provision is codified as the second sentence of Section 81.2.D in TRPA's Code of Ordinances. In recognition of the need for further study of the operation of powered watercraft on Lake Tahoe, the Governing Board indicated that additional research should be undertaken. In response to this new data, TRPA should consider (1) whether the management direction chosen was appropriate, and (2) if so, whether any refinement of the ordinance was necessary.

This Environmental Assessment (EA) supports the December 1998 Governing Board direction, after consideration of the new data, to affirm the fundamental approach to motorized watercraft and to implement certain refinements. This EA provides a background of the 1997 actions, summarizes the findings of the recent motorized watercraft studies, and assesses any potential impacts to the environment associated with the Governing Board's direction and two other alternatives.

1.2 Background

1997 Actions

Section 81.2.D of Chapter 81 of the TRPA Code of Ordinances prohibits the discharge of toxic hazardous waste to the waters of the Lake Tahoe Basin. In February 1997, the TRPA Governing Board held an extensive hearing on the impacts of motorized watercraft in the Lake Tahoe Basin. The Governing Board heard substantial and compelling evidence that watercraft powered by certain types of two-stroke engines degrade water quality by discharging significant amounts of oil and gas directly into Lake Tahoe and at highly disproportionate rates compared to other motorized watercraft. Data then available indicated that watercraft powered by carbureted two-stroke engines emit toxic pollutants (including methyl tertiary-butyl ether, benzene, ethylbenzene, toluene, and xylene) at a rate ten times higher than watercraft powered by other engine types.

In response to this, and other information, TRPA undertook the following actions. In March 1997, the Governing Board adopted a resolution requesting assistance from other public agencies in the Lake Tahoe Basin to conduct further study of the problem. In June 1997, the Governing Board adopted Ordinance 97-12 which prohibited the use of watercraft powered by carbureted two-stroke engines, created a 600 foot "no-wake" zone, and banned operation of motorized watercraft in tributary waters. The Governing Board also adopted a list of other watercraft-associated issues to be addressed in the Shorezone Consensus/EIS process (to be completed in 1999) and enforcement and education programs to be included in the TRPA Work Program.

In response to the March 1997 resolution requesting assistance, a Motorized Watercraft Technical Advisory Group (MWTAG) was formed.

Figure 1. Motorized Watercraft Technical Advisory Group

Tahoe Regional Planning Agency	Nevada Division of Environmental Protection	U.S. Geological Survey	National Marine Manufactures Association
California Air Resources Board	State and Lahontan Water Quality Control Boards	Environmental Protection Agency	Nevada Division of Wildlife
Tahoe Research Group	University of Nevada Reno	Lake Tahoe Marinas	California Boating and Waterways

MWTAG members devised a series of scientific studies and monitoring efforts commencing in the spring of 1997 to further investigate the magnitude of fuel pollution from motorized watercraft. In December 1997, the Governing Board considered possible amendments to Ordinance 97-12. The Governing Board decided to defer further action to permit the completion and consideration of the MWTAG studies.

Results of the MWTAG and Related Studies

During 1997 and 1998, MWTAG members and others conducted at least 10 different studies relevant to motorized watercraft in the Tahoe Basin. These studies are synthesized in the *Lake Tahoe Motorized Watercraft Report – An Integration of Water Quality, Watercraft Use and Ecotoxicology Issues (Report)*, appended hereto. As indicated in the *Report*, the results of these studies confirm the two basic justifications relied upon by the Governing Board to adopt Ordinance 97-12: (1) petroleum products are in the lakes of the Region as a result of motorized watercraft operation, and (2) watercraft powered by old technology two-stroke engines discharge pollutants at an order of magnitude greater than do watercraft powered by newer technology engines.

The *Report* synthesized studies completed in 1997 and 1998, most of which studied the impacts of motorized watercraft specifically on Lake Tahoe. The referenced studies[1] include the following:

1. Miller & Fiore, (unpublished report), Release of Gasoline Constituents into Lake Tahoe from Different Watercraft.

2. Miller & Fiore, (unpublished data), Graphical Summary of Lab Results from Nearshore MTBE and BTEX Monitoring in Lake Tahoe – 1977.

3. USGS Survey of Manmade Organic Compounds in Lake Tahoe and Selected Tributaries – preliminary data from 1998.

4. Boughton and Lico (1998) – Volatile Organic Compounds in Lake Tahoe, Nevada and California, July-September 1997.

[1] Some studies are not yet complete, and will continue into the 1999 boating season. Preliminary results have been provided where indicated.

5. Tahoe Research Group (unpublished data) – 1998 Monitoring data for MTBE and BTEX in Lake Tahoe.

6. Reuter et al (1998) – Sources, Fate and Transport of Gasoline Oxygenate MTBE in a Multiple Use Lake.

7. Kleppe (1998 Report) – Fallen Leaf Lake: Watercraft Issues.

8. Oris and others. (1998). Toxicity of Ambient Levels of Motorized Watercraft Emissions to Fish and Zooplankton in Lake Tahoe, California-Nevada, USA.

9. Hagler Bailly, Inc. (1998 preliminary report) – Watercraft Use Study, Lakes of Tahoe.

10. California Air Resources Board (1998 unpublished data) – Exhaust Emissions from Selected Marine Engines.

The *Report* summarizes the results of the studies with the following principal findings:

1. MTBE (methyl tertiary butyl ether) and BTEX (benzene, toluene, ethylbenzene, zylene) compounds have been measured at concentrations above the analytical limit of detection at a number of nearshore locations in Lake Tahoe and in other lakes in the Tahoe basin which allow motorized watercraft.

2. These compounds, as well as PAHs (polycyclic aromatic hydrocarbons), appear directly related to motorized watercraft activity.

3. In areas of high watercraft use on the order of 50-100 marine engines in operation (e.g. Ski Run Marina region), concentrations of MTBE and benzene were found to exceed drinking water standards. The occurrence of high watercraft use near drinking water intake lines could result in contamination.

4. The calculated mean values for MTBE and BTEX as monitored in the nearshore of Lake Tahoe did not exceed drinking water standards.

5. At no time did ambient concentrations of MTBE or BTEX approach criteria for protection of aquatic life.

6. Polycyclic aromatic hydrocarbons (PAHs) were present in Lake Tahoe waters in sufficient concentration to cause negative impacts on biota. Ultraviolet radiation-induced toxicity of PAH was found to be significant for fish growth and zooplankton survival. However, zooplankton reproduction was also effected in the no-UV treatments indicating a direct toxicity. Calculated N.O.E.C levels (no observable effect concentration) for phototoxic PAH ranged from 3.4 – 9.0 ng/L. Values for total PAH ranged from 5-70 ng/L.

7. Concentrations of MTBE and BTEX at the open-water sampling station (mid-lake) were very low and either near or below the analytical limit of detection.

8. Complete depth sampling from the surface to 450 m, gave no indication that MTBE or BTEX was either transporting to depth or accumulating in the Lake. Concentrations dropped at the end of the summer boating season and was consistent with other studies.

9. Sampling of intake water by drinking water purveyors has been limited. No data indicates any violation of drinking water standards at the locations sampled.

10. The total amount of fuel used at Lake Tahoe during the 1998 boating season was approximately 1.5 million gallons. Two-cycle carbureted marine engines, including personal watercraft (PWCs) and outboards used only 11-12 percent. A full 87 percent was used by 4-cycle inboard/outboard engines, the types associated with ski boats and pleasure craft.

11. Field and lab experiments demonstrated that the two-cycle carbureted models had the largest percent of unburned fuel passing through the engine and into the water. For MTBE, the two-cycle outboard engines were the least efficient. Over 30 percent of the MTBE initially contained in the watercraft's fuel tank was deposited into the water during operation. Similarly, 10 percent of the MTBE in fuel used by the PWCs was loaded to the Lake. Values for both categories of 4-cycle engines were lower, at 2.3 percent and 0.2 percent for 4-cycle outboards and 4-cycle inboard/outboards and inboards, respectively. The results for benzene and toluene were similar.

12. Based on the volumes of fuel used by each class of engine as reported by the watercraft use study, and the calculated soluble fractions, carbureted two-cycle engines contributed a disproportionate load of MTBE, benzene, and toluene to Lake Tahoe. Combining PWC and two-cycle outboard classes to represent the two-cycle carbureted engines, they contributed over 90 percent of the MTBE to Lake Tahoe, while only utilizing about 11-12 percent of the total fuel. Similarly these engines were responsible for over 70 percent of the benzene and 80 percent of the toluene deposited during the boating season. In contrast to this, the four-cycle inboard and inboard/outboard class consumed 87 percent of the fuel used by boating on Lake Tahoe but was responsible for 8 percent of the estimated MTBE, 28 percent of the estimated benzene, and 17 percent of the estimated toluene loading to the Lake.

13. Estimated gallons of constituent load to Lake Tahoe during the 1998 boating season from 2-cycle engines was on the order of thousands of gallons of MTBE, hundreds of gallons of benzene, and ten's of hundreds of gallons of toluene.

14. Field testing using engines with the newer fuel injection system (Ficht Injected) revealed that nearly 90 percent of the MTBE, 70 percent of the benzene, and 80 percent of the toluene would not have been deposited into the lake had this technology been in full use in 1998, i.e., if all 2-cycle carbureted engines been replaced with this, or a similar effective technology.

15. The potential for increased NO_X emissions from motorized watercraft engines was estimated as negligible as compared to the impact of automobile exhaust.

16. Future study needs: (1) expanded monitoring of nearshore and open-water portions of the lake to evaluate the effect of management decisions (a focus should be placed on those areas where drinking water intakes are located) and (2) additional PAH studies are essential. PAH monitoring was not sufficient for us to assess the spatial, temporal, or depth distribution of these compounds. In addition, engine emission studies did not include PAH. Given the available ecotoxicology for PAHs in Lake Tahoe, a carefully conducted study which includes (a) distribution of PAH, (b) PAH emission tests from marine engines under operating conditions, (c) more comprehensive ecotoxicity experiments using biota resident to Lake Tahoe, and (d) ecological risk assessment is strongly recommended.

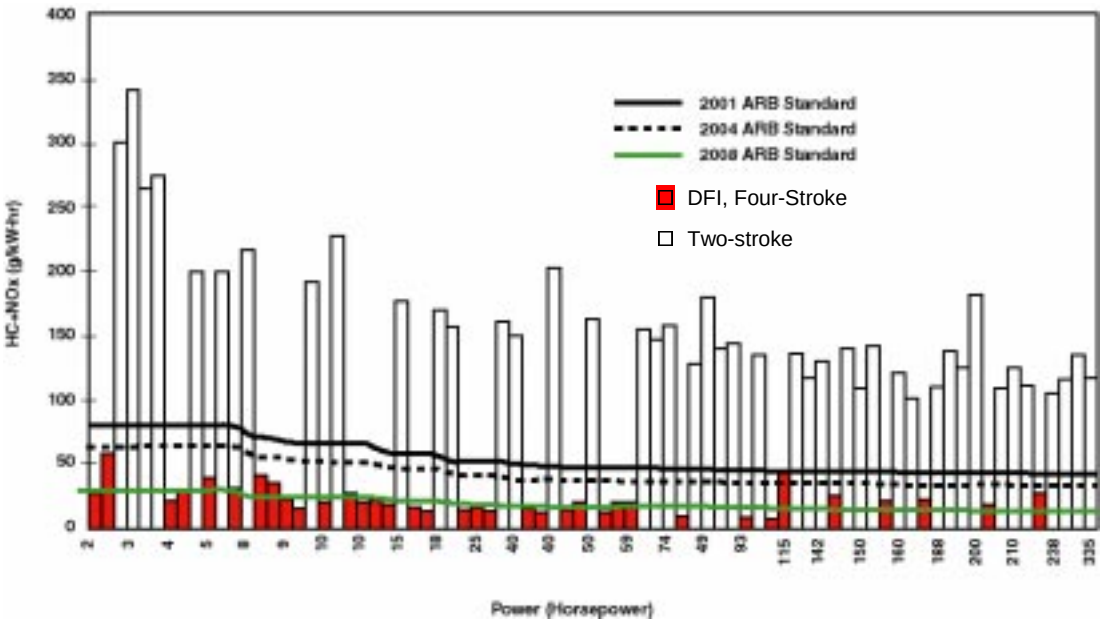
1998 CARB Action

During 1998, the California Air Resources Board (CARB) studied and implemented regulations in regards to motorized watercraft. The October 23, 1998 Staff Report Executive Summary stated:

> *Based on the latest emissions estimates, outboard and personal watercraft engines account for 777 tons per day of reactive organic gas (ROG) and NOx emissions on weekend summer days (days which are associated with peak ozone episodes). An example of the impact of emissions for a single engine is the comparison between the operation of a personal watercraft to the emissions of a passenger car. The operation of a 100 horsepower personal watercraft for 7 hours results in more ozone precursor emissions (hydrocarbons + oxides of nitrogen) than the operation of a 1998 passenger car over 100,000 miles.* ***Carbureted two-stroke engines discharge as much as 25 to 30 percent unburned fuel into the water and subsequently into the air. For example, a typical personal watercraft consuming five gallons of gasoline per hour and operated 41 hours per year, discharges between 50 and 60 gallons of unburned fuel into the environment. Consequently, in addition to air quality impacts, since marine engines exhaust through the water, water quality is also impacted.***

CARB worked with TRPA, the California State Water Quality Control Board, the Lahontan Regional Water Quality Control Board, and other water quality oriented agencies to establish emission standards that would also assist in the protection of water quality. Figure 2 demonstrates how CARB created a phased program (three tiers) to eliminate the undesirable watercraft through prohibition of new sales (and eventual replacement of existing, grandfathered, old technology engines). As demonstrated by Figure 2, the emissions from carbureted two-strokes will be over the limit set for the first, 2001, tier. These are the watercraft described in bold above and are targeted for prohibition by TRPA.

Figure 2. All U.S. EPA 1998-1999 Certified Marine Engine Families Including Two-Stroke Carbureted, Two-Stroke Direct Injection, and Four-Stroke Technologies.



Another CARB action important to TRPA is the establishment of emission standards for 2004 and 2008 which are more restrictive on sales than the EPA. (See Table 1). Although TRPA's prohibition is equal to CARB's 2001 standard, TRPA will get the benefit of cleaner technology sales limits in 2004 and 2008.

Table 1. CARB HC and NOx Exhaust Emission Standards (grams/kilowatt-hour)

	Tier 1	Tier 2	Tier 3
Implementation Date	2001	2004	2008
Percent of U.S. EPA 2006 Standard	100%	80%	50%

1.3 Purpose and Proposed Action

At the December 1998 TRPA Governing Board meeting, the Governing Board held a public hearing on the research results presented in the *Lake Tahoe Motorized Watercraft Report – An Integration of Water Quality, Watercraft Use and Ecotoxicology* and other recent reports. After hearing the testimony and reviewing the evidence, the Governing Board directed TRPA staff to draft amendments that extend the prohibition to electronic fuel injected two-stroke powered watercraft commencing October 2001 and reword the ordinance to clarify the prohibition. For the January 1997 Governing Board meeting, staff was to directed prepare the necessary findings, environmental documents, and ordinances for presentation. The ordinances include the following:

A. Minor adjustments to the Goals and Policies to clarify TRPA's role in motorized watercraft regulation.

B. Rewording the Code language for the June 1, 1999 prohibition of carbureted two-stroke propelled watercraft to prohibit the operation, mooring, or launching of watercraft powered by two-stroke engines except:

   1. Any watercraft powered by a two-stroke engine whose fuel is directly injected into the cylinder shall be exempt from the prohibition, or

   2. Any watercraft powered by a two-stroke engine whose fuel is injected into the crank-case prior to entering the cylinder shall be prohibited commencing October 1, 2001.

1.4 Responsible Agencies

Watercraft activities are also subject to regulation by the following agencies: (The text in the brackets notes the agency's primary concern.)

° California State Lands (ownership and leasing mooring and launching facilities)

° California Air Resources Board (air quality)

° Nevada State Lands (ownership and leasing of mooring and launching facilities)

° Nevada Department of Wildlife (fisheries, wildlife, boating safety)

° California Department of Fish and Game (fisheries, wildlife)

° U.S. Environmental Protection Agency (water and air quality)

° U. S. Army Corps of Engineers (navigation/wetlands)

° U. S. Coast Guard (boating safety)

° U. S. Fish and Wildlife (fisheries, wildlife, endangered species)

° Nevada Department of Environmental Protection (air and water quality)

° California Regional Water Quality Control Board Lahontan Region (water quality)

° Local sheriff and police (law enforcement)

1.5 Alternatives

The alternatives considered in this environmental assessment are specific to the limited scope of the December 1998 Governing Board direction. All the alternatives assume that TRPA will pursue the other studies programs and regulations that were recommended in the February 1997 Governing Board action. This includes an air quality fee focused on mitigation of NOx emissions from watercraft, a program to implement boating and fueling BMPs, regulations limiting the use of motorized watercraft, and the eventual elimination of MTBE as a fuel additive. All of the alternatives also assume that EPA and CARB regulations will be implemented.

The alternatives are as follows:

Alternative 1: No Project – June 1997 Prohibition in Effect

Under this alternative, the TRPA takes no action. The prohibition of carbureted two-stroke powered watercraft starting June 1, 1999 remains as adopted.

Alternative 2: Proposed Action

This alternative is based on the direction of the Governing Board in December of 1998. This alternative assumes all the existing regulations and the adoption of new regulations to clarify the prohibition. The regulations would:

A. Make minor adjustments to the Goals and Policies to clarify TRPA's role in motorized watercraft regulation.

B. Reword the Code language for the June 1, 1999 prohibition of carbureted two-stroke propelled watercraft to prohibit the operation, mooring, or launching of watercraft powered by two-stroke engines except:

   1. Any watercraft powered by a two-stroke engine whose fuel is directly injected into the cylinder shall be exempt from the prohibition,

   2. Any watercraft powered by a two-stroke engine whose fuel is injected into the crank-case prior to entering the cylinder shall be prohibited commencing October 1, 2001,

Alternative 3: Alternative 2, with Exemptions

This alternative has the same assumptions as Alternative 2, except it considers the following exemptions to the regulation phasing out of carbureted two-stroke engines. For purposes of this analysis, the first three exemptions are limited to three boating seasons and use the same date for practical enforcement reasons:

1. Exempt sailboats utilizing carbureted two-stroke engines as auxiliary power until October 1, 2001.

2. Exempt watercraft using outboard carbureted two-stroke engines under 10 horse power until October 1, 2001.

3. Exempt watercraft used for fire protection until October 1, 2001.

4. Exempt watercraft powered by a two-stroke engine whose engine is certified by the Environmental Protection Agency as meeting the U.S. EPA 2006 standard or is certified by the California Air Resources Board as meeting the CARB 2001 standard.

2.0 Update to 1997 Motorized Watercraft Assessment

This EA builds on the information contained in the 1997 Motorized Watercraft Assessment ("1997 EA"), prepared in connection with the adoption of Ordinance 97-12. The impact analysis conducted herein incorporates relevant portions of the 1997 EA where appropriate. The 1997 EA is available for public review at the TRPA offices, 308 Dorla Court, Elks Point, Nevada.

2.1 Watercraft Use Estimates

In order to assess the impacts of modifying the motorized watercraft use, TRPA needs estimates of boating use. At this time, there are no official boating use or projections numbers for Lake Tahoe. When the June 1997 EA was prepared there were no official annual counts of watercraft usage at Lake Tahoe so staff prepared estimates of Chapter 2 of the 1997 EA for impact analysis purposes.

Since then, the *Lake Tahoe Motorized Watercraft Report – An Integration of Water Quality, Watercraft Use and Ecotoxicology* was completed and it includes a preliminary watercraft usage study for the summer of 1998. Chapter 2 of the 1998 Hagler Bailly *Watercraft Use Study Lake of Tahoe Preliminary Report* (in progress) presents boating use data from the summer of 1998. The *HB Report* includes surveys at boat ramps and marinas, of homeowners, and of concessionaires. The following Table 2, TRPA Boating and Fuel Use Estimates, incorporates the HB Report and represents TRPA's update of the June 1997 Motorized Watercraft EA's estimates found in Figure 2-12.F. Again, these counts and projections are TRPA estimates based on improved but still limited information.

1998 Use Estimates

TRPA has attempted to build an estimate of a 1998 base year by combining the three Hagler Bailly surveys. TRPA has made some assumptions in developing the 1998 estimates because the surveys are not complete, there is insufficient data in some boating categories, and because of the difference in questions found in the surveys. The new information is based on a shorter boating season (Memorial Day weekend to Labor Day weekend) than the May 15 to September 15 estimate used in the 1997 EA.

Other modifications included:

- TRPA used the 1997 estimates for diesel powered sailboats since there were no 1998 survey estimates available;
- As there were no data for direct fuel injection engine fuel use rate, TRPA reduced the carbureted PWC fuel use rate estimate by 25%;
- As the homeowner survey contained no estimates for outboard two-stroke/four-stroke watercraft, the distribution is assume to be the same as the boat ramp/marina survey estimates; and
- The fuel use figures for two-stroke outboard use required adjustment due to limited samples.

Since only 12 of the 18 (66%) concessionaire surveys were completed, the use estimate was increased by 25%. A lower percentage was used because most of the unreturned surveys were from smaller operations. The distribution of types of watercraft is assumed to be the same as the 12 returned surveys.

Table 2. TRPA BOATING FUEL USE ESTIMATES - BOATING SEASON*

Private Watercraft	Engine Type[1]	1978 Fuel Use G/Hour	1978 Hours/trip	1978 % Trips	1978 Boat Trips	1978 Fuel Use Gal.	1998 Fuel Use G/Hour	1998 Hours/trip	1998 % Trips	1998 Boat Trips	1998 Fuel Use Gal.	2008 Fuel Use G/Hour	2008 Hours/trip	2008 % Trips	2008 Boat Trips	2008 Fuel Use Gal.
Up to 10 hp	G2						0.99	2.1		2,634	5,476					
10 to 30 hp	G2						1.33	2.3		1,802	5,512					
Over 30 hp	G2						1.98	3.7		9,428	69,070					
Outboard Total	G2	1.81	3.19	20.2%	21,204	122,430	1.81	3.19	8.4%	13,865	80,055	1.81	3.19	0.0%	-	-
Auxiliary Sail	G2	0.16	5.8	1.7%	1,784	1,673	0.16	5.8	1.6%	2,641	2,477	0.16	5.8	0.0%	-	-
Outboard	G4/G2I	1.58	3.49	3.5%	3,674	20,259	1.58	3.49	3.4%	5,612	30,946	1.58	3.49	11.5%	22,118	121,963
Inboard/Outboard	G4	3.76	3.16	43.4%	45,556	541,278	3.76	3.16	43.2%	71,306	847,229	3.76	3.16	42.5%	81,742	971,226
Inboard	G4	3.06	3.25	28.6%	30,021	298,559	3.06	3.25	28.5%	47,042	467,833	3.06	3.25	28.1%	54,046	537,487
Inboard Jet	G4	3.08	3.88	0.9%	945	11,293	3.08	3.88	0.8%	1,320	15,775	3.08	3.88	0.9%	1,731	20,686
Auxiliary Sail	G4	0.16	5.8	0.7%	735	689	0.16	5.8	0.6%	990	929	0.16	5.8	2.3%	4,424	4,150
Inboard	D	1.2	4.69	0.1%	105	591	1.2	4.69	0.1%	165	929	1.2	4.69	0.1%	192	1,081
Auxiliary Sail	D	0.16	5.8	0.9%	945	886	0.16	5.8	0.9%	1,486	1,394	0.16	5.8	0.9%	1,731	1,624
PWC[2]	G2	0	0	0.0%	-	-	1.82	2.34	12.5%	20,633	87,872	1.82	2.34	0.0%	-	-
PWC[2]	G4/G2I	0	0	0.0%	-	-	1.09	2.34	0.0%	-	-	1.09	2.34	13.7%	26,350	67,208
Total Watercraft Trips Input					104,968					165,061					192,334	
Total Watercraft Trips/Fuel Use				100.0%	104,967	997,652			100.0%	165,060	1,535,156			100.0%	192,334	1,725,425
Concessionaire																
Two stroke	G2	2.63	1.77	77.5%	15,862	73,839	2.63	1.77	70.9%	22,674	105,550	2.4	2.08			
Two stroke DFI	G2 DFI						3.17	1.04	6.5%	2,079	6,854	3.17	1.04	77.5%	28,502	93,965
Four Stroke	G4	3.24	4.66	22.5%	4,605	69,528	3.24	4.66	22.5%	7,196	108,648	2.7	6.32	22.5%	8,275	141,205
Concession Input					20,467					31,980					36,777	
Concession Total				100.0%	20,467	143,367			99.9%	31,949	221,052			100.0%	36,777	235,170
Total Motorized Watercraft					**125,434**	**1,141,019**				**197,040**	**1,756,208**				**229,111**	**1,960,595**

* See text above for assumptions

Shaded area is a TRPA estimate of the boat use by horsepower for two-stroke outboards. Because of different fuel use information, the horsepower breakdown does not equal the total fuel use for outboards.

[1] Engine types:
- G2 — Two-stroke carbureted and EFI engine
- G4 — Four-stroke carbureted engine
- G2I — Two-stroke direct fuel injection engine
- Diesel — Diesel

[2] Personal Watercraft

2008 Future Use Projections

Based on past trends described in Chapter 2, TRPA is estimating a 15% growth in boating use for the next ten years. These projections reflect EPA estimated trends (Chapter 2, Figure 2-11 of the 1997 EA) for increased PWC use and decreased outboard use. The TRPA prohibition on carbureted two-stroke powered watercraft is included in this projection. TRPA's assumption is that by 2008 as a result of TRPA's ordinances, the old technology engines will be replaced by four-stroke and direct fuel injection two-stroke engines without affecting overall use.

1978 Use Estimates

The 1978 *Cumulative Impacts of Shorezone Development at Lake Tahoe Report* estimated shorezone usage on a per day basis for weekdays, weekends, and peak weekends in the year 1978. See EA, Chapter 2, Figure 2.1, which is incorporated herein by reference. Because there is no boating study for 1980, staff relied on this study to establish boating use and fuel use level related to the 1980 designation of Lake Tahoe as Outstanding National Resource Water. Staff assumed the same distribution of watercraft type except that there was no PWC use at that time. It is not clear in the 1978 study if the concessionaire use was included. It is TRPA's assumption based on the low use numbers that they were not included. Therefore, TRPA adjusted 1978 numbers and used a reduced 1998 estimate equal to the difference between the overall usage estimates.

Table 3. 1978 MTBE, Benzene, and Toluene Discharge by Engine Type and Gallons of Gasoline Used.

	Engine Type	1978 Total Fuel Use, Gals	1978 Unburnt Soluble Fuels (Gals)	Gals MTBE (Less Diesel Contribution)	Gals Benzene	Gals Toluene
Personal Watercraft						
Outboard Total:	G2	122,430	12,243	5,314	213	1,205
Auxiliary Sail	G2	1,673	167	73	3	17
Outboard	G4/G2I	20,259	203	65	7	21
Inboard/Outboard	G4	541,278	5,413	157	43	130
Inboard	G4	298,559	2,986	84	24	72
Inboard Jet	G4	11,293	113	3	1	3
Auxiliary Sail	G4	689	7	0	0	0
Personal Watercraft	G2	0				
Personal Watercraft	G4/G2I	0				
Watercraft Totals:		997,658	21,131	5,690	291	1,447
Concessionaire Watercraft						
Two-Stroke	G2	73,839	7,384	3,205	129	727
Two-Stroke DFI	G2 DFI	0	0	0	0	0
Four-Stroke	G4	69,528	695	20	6	17
Concessionaire Totals		143367	8,079	3,224	134	743
Total Motorized Watercraft:		**1,141,025**	**29,210**	**8,914**	**425**	**2,190**

Table 4. 1998 MTBE, Benzene, and Toluene Discharge by Engine Type and Gallons of Gasoline Used.

	Engine Type	1998 Total Fuel Use, Gals	1998 Unburnt Soluble Fuels, Gals	Gals MTBE	Gals Benzene	Gals Toluene
				(Less Diesel Contribution)		
Private Watercraft						
Up to 10 hp	G2	5,476	548			
10 to 30 hp	G2	5,512	551			
Over 30 hp	G2	69,070	6,907			
Outboard Total:	G2	80,055	8,006	3474	139	788
0uxiliary Sail	G2	2,477	248	108	4	24
Outboard	G4/G2I	30,946	309	100	11	32
Inboard/Outboard	G4	847,229	8,472	237	68	203
Inboard	G4	467,833	4,678	131	37	112
Inboard Jet	G4	15,775	158	4	1	4
Auxiliary Sail	G4	929	9	0	0	0
Personal Watercraft	G2	87,872	8,787	1,230	141	773
Personal Watercraft	G4/G2I					
Watercraft Totals:		1,535,439	30,668	5,285	402	1,937
Concessionaire Watercraft						
Two-Stroke	G2*	105,550	10,555	4,581	184	1,039
Two-Stroke DFI	G2 DFI**	6,854	69	22	3	7
Four-Stroke	G4***	108,648	1,086	30	9	26
Concessionaire Totals		221,052	11,710	4,633	195	1,072
*Outboard Factor Applied						
**4-Stroke OB Applied						
***4-Stroke IO Applied						
Total Motorized Watercraft:		**1,756,491**	**42,378**	**9,918**	**597**	**3,009**

Table 5. 2008 MTBE, Benzene, and Toluene Discharge by Engine Type and Gallons of Gasoline Used. (Projected)

	Engine Type	2008 Total Fuel Use, Gals	1998 Unburnt Soluble Fuels (Gals)	Gals MTBE	Gals Benzene	Gals Toluene
				(Less Diesel Contribution)		
Private Watercraft		0		0	0	0
Outboard Total:	G2	0		0	0	0
Auxiliary Sail	G2	0		0	0	0
Outboard	G4/G2I	121,963	1,220	393	44	127
Inboard/Outboard	G4	971226	9,712	272	78	233
Inboard	G4	537,487	5,375	151	43	129
Inboard Jet	G4	20,686	207	6	2	5
Auxiliary Sail	G4	4,150	42	1	0	1
Personal Watercraft	G2	0		0	0	0
Personal Watercraft	G4/G2I	67,208	672	216	24	70
Watercraft Totals:		1,725,425	17,227	1,039	191	565
Concessionaire Watercraft						
Two-Stroke	G2	0	0	0	0	0
Two-Stroke DFI**	G2 DFI	93,965	940	303	34	98
Four-Stroke***	G4	141,205	1,412	40	11	34
Concessionaire Totals		235,170	2,352	342	45	132
Total Motorized Watercraft:		**1,960,595**	**19,579**	**1,381**	**236**	**696**

Discharges calculated using the following assumptions:

During 1998 Boating Season, PWC G4/G2I are not in use.

During 2008 Boating Season, Outboard G2 and PWC G2 no longer operating on Lake Tahoe.

Fuel Used calculated using Watercraft Use Study, Lakes of Tahoe (1998) data, Table 2-5, Estimated Boating Hours and Fuel Use for Motorized Watercraft – Lake Tahoe, Boat Ramp/Marina Sample and Concessionaire Survey Results.

Fuel used does not include diesel component.

Outboard factor applied to concessionaire two-stroke engines.

Four-stroke OB factor applied to concessionaire two-stroke DFI engines.

Four-stroke I/O factor applied to concessionaire four-stroke engines.

Gallons of Constituent Discharged = Gallons Used x %Constituent by Wt. x %Constituent Solubility. %Constituent by Wt and Solubility Factors obtained from Lake Tahoe Motorized Watercraft Report (1998).

Percent of constituent that is soluble varies by engine type.

Conversion of gallons of gasoline (California Certified w/MTBE added as oxygenate) to gallons of MTBE, benzene, and toluene by engine type utilized factors below:

MTBE		***Benzene***		***Toluene***	
PWC. G2	0.014	PWC, G2	0.0016	PWC, G2	0.0088
Two-Stroke OB	0.0434	Two-Stroke OB	0.00174	Two-Stroke OB	0.00984
4-Stroke OB	0.00322	4-Stroke OB	0.00036	4-Stroke OB	0.00104
4-Stroke I/O	0.00028	4-Stroke I/O	0.00008	4-Stroke I/O	0.00024

2.2 Water Quality Update

Environmental Setting and Introduction:

Section 3.1 of the 1997 EA provides an introduction and background information regarding water quality at Lake Tahoe. As set forth in section 3.1, Lake Tahoe is an exceptionally clear lake, which has been threatened by increasing development in the Tahoe Basin. Because contaminants can remain in the Lake for as long as 700 years before they are flushed out, Lake Tahoe is particularly vulnerable to the adverse cumulative impacts of water pollution. The discussion in section 3.1. is incorporated herein by reference.

In section 3.3, the 1997 EA discusses the environmental setting in Lake Tahoe prior to adoption of Ordinance 97-12 and is incorporated herein by reference. This discussion identifies sources of water pollution related to motorized watercraft and estimates water pollution in the form of fuel loadings and nitrogen oxides assuming that no restrictions on the use of carbureted two-stroke engines were adopted. Watercraft powered by carbureted two-stroke engines discharge as much as 25% of their fuel unburned directly into the waters where they operate. Although EPA has adopted regulations to reduce hydrocarbon emissions from outboard and personal watercraft engines by 75 percent, these regulations will be phased in over a period extending through 2025. In addition, the EPA regulations would continue to allow the operation of older technology and is based on a nationwide average of emissions. The 1997 EA concluded that, without regulation of carbureted two-stroke engines, significant impacts to water quality in the Tahoe basin would occur. See pages 3-11 & 3-12 of the 1997 EA.

CARB regulations adopted since adoption of Ordinance 97-12 are predicted reduce pollution from motorized watercraft over existing levels. However, CARB regulations do not take effect until January 1, 2001 and like the EPA regulations, they will “grandfather” the continued use of existing watercraft powered carbureted two-stroke engines. Thus, the continued use of these watercraft is expected to adversely impact water quality at the Lake.

In response to the research needs identified in the 1997 EA, the MWTAG was formed which developed, coordinated, and implemented a research plan focused on the potential water quality and limnological impacts of motorized watercraft on Lake Tahoe. Among the many objectives of the studies were the evaluation of the transfer and fate of hydrocarbons and emission by-products, the identification of various classes of watercraft, the assessment of hazards and risk to human health and aquatic life, and the quantification of the magnitude of all unburned fuels by type of watercraft and spillage. The individual studies were divided up between the participants and the information obtained was used to prepare the *Report*. The major studies are:

- In Lake Watercraft Tests – University of Nevada Reno and Lahontan
- Watercraft Tank Test – California Air Resources Board
- Lake and Stream Monitoring – U.S. Geological Survey
- MTBE Monitoring – Tahoe Research Group
- Boating Use Survey - Nevada Division of Wildlife and California Boating and Waterways

As discussed below, none of these studies indicates that banning the use of watercraft powered by carbureted two-stroke engines will result in significant adverse water quality impacts.

Water Quality Evaluation Criteria:

It is important to note that before TRPA can approve any ordinance, TRPA must find that "Wherever federal, state, and local air and water quality standards applicable to the Region, whichever are stricter, must be attained and maintained pursuant to Article V(d) of the Compact, the project meets or exceeds such standards." The water quality standards at Lake Tahoe generally focus on two areas:

1. Clarity – reducing the loads of sediment and nutrients to Lake Tahoe.
2. Pollutants – controlling pollutants affecting water quality.

Standards:
The 1997 EA analyzed loading of unburned fuel as gasoline, whereas studies completed by the University of Nevada at Reno, the University of California at Davis, and the California Air Resource Board produced data which enabled the Tahoe Research Group and TRPA to calculate loadings of unburned gasoline *constituents* including methyl-tertiary-butyl-ether (MTBE), benzene and toluene. The 1998 Lake Tahoe Motorized Watercraft Report then assessed the significance of discharges of these constituents from motorized watercraft relative to drinking water quality standards and risk to aquatic life. Risk was evaluated by comparing concentrations of constituents found in Lake Tahoe and other lakes impacted by motorized watercraft activity to state drinking water quality standards and action levels with respect to aquatic life. Critical concentration levels for five gasoline constituents are outlined in Table 6, Drinking Water Quality Standards and Aquatic Life Protection Criteria, below:

Table 6. Drinking Water Quality Standards and Aquatic Life Protection Criteria

For comparative purposes, the drinking water standards from both California and Nevada for MTBE and the BTEX compounds are listed below. Also included are values for taste and odor thresholds (action levels) and aquatic life toxicity, as available. All values are expressed as µg/L.

CONSTITUENT & CRITERIA	***CA***		***NV***
MTBE			
Primary Drinking Water Standard	14*		20
Secondary Drinking Water Standard	5*		---
Taste & Odor Threshold•		---	
Aquatic Life – M.A.T.C. ¥		66,000[a]	
BENZENE			
Primary Drinking Water Standard	1		5
Secondary Drinking Water Standard	---		---
Taste & Odor Threshold•		---	
Aquatic Life – Acute L.O.E.L. †		5,300	
ETHYLBENZENE			
Primary Drinking Water Standard	700		700
Secondary Drinking Water Standard	---		---
Taste & Odor Threshold•		29	
Aquatic Life – Acute L.O.E.L. †		32,000	
TOLUENE			
Primary Drinking Water Standard	150		1000
Secondary Drinking Water Standard	---		---
Taste & Odor Threshold•		42	
Aquatic Life – Acute L.O.E.L. †		17,900	
XYLENE			
Primary Drinking Water Standard	1,750		10,000
Secondary Drinking Water Standard	---		---
Taste & Odor Threshold•		17	
Aquatic Life – Acute L.O.E.L. †		---	

* Proposed by CAL-DHS
¥ Maximum Allowable Toxic Concentration
† Lowest Observable Effect Level – US EPA
[a] Mancini and Stubblefield (1977)
• US EPA – Federal Register (1989)

These analyses have allowed TRPA staff to improve the quantitative analysis of motorized watercraft impacts with respect to type and intensity of motorized watercraft use. The ability to quantify loading of gasoline constituents is also important with respect to the interpretation of Lake Tahoe's Outstanding National Resource Water (ONRW) status which requires Lake Tahoe's water quality to be *maintained* and protected. Since total gallons of gasoline consumed by various watercraft/engine types result in varying emission loads of different gasoline constituents to the air and water, and since only a fraction of the 70+ constituents commonly found in gasoline have been studied on Lake Tahoe and other lakes of the region, analysis of gasoline emissions loading by quantification of specific gasoline constituents is required.

Comparison of only gallons of gasoline consumed would require the reduction of numbers of boats to levels observed in 1980, in order to maintain fuel loadings.

Water Quality Impacts:

Impacts to water quality are caused by a variety of environmental conditions that increase the total loading of contaminants, both from watershed sources and in-Lake sources. A proposed alternative is determined to have a significant environmental impact if it will cause a significant increase in nutrient loading or other pollution in Lake Tahoe, or if it will cause exceedences of the water quality standards identified in the previous section.

The 1997 EA evaluated the impacts of restricting the use of watercraft powered by carbureted two-stroke engines in the Tahoe Basin and determined that there were no significant, unmitigatable environmental impacts associated with such restrictions. See page 3-13 of the 1997 EA. Ordinance 97-12, which currently prohibits the use of carbureted two-stroke engines beginning June 1, 1999, will benefit water quality by reducing the discharge of unburned fuel and its constituents into the waters of the Tahoe Basin.

As demonstrated by Table 7, analysis of loadings of gasoline constituents also indicates that restrictions on two-stroke engines will benefit water quality. Due to the conversion of two-stroke engines to direct injection and four-stroke technologies, gasoline consumption by motorized watercraft on Lake Tahoe is projected to increase by 927,751 gallons from 1978 to 2008, as indicated in Table 7; however, discharges of MTBE, benzene, and toluene decrease significantly in boating year 2008. Since MTBE was not present as an oxygenate in 1978, the application of ONRW standards requires the phase-out of MTBE as an oxygenate additive in gasoline marketed in the Tahoe Region.

Assuming a phase-out of MTBE, although gasoline consumption increases, benzene and toluene loads decrease. With respect to maintenance of the character of water quality as mandated by ONRW standards, the benzene and toluene discharges are acceptable.

Table 7. Summary of MTBE, Benzene and Toluene Discharge and Gallons of Gasoline Used Under Alternative 1

			MTBE	Benzene	Toluene
	Fuel Used	Unburnt Soluble Fuels (Gals)	Discharged	Discharged	Discharged
1978 Boating Season	1,141,025	29,210	0	405.4	2189.9
1998 Boating Season	1,756,491	42,378	9,918	597	3,009
2008 Boating Season	1,960,595	19,579	1,381	236	696

All volumes measured in gallons.

Methyl-Tertiary-Butyl Ether (MTBE)*:* MTBE is a petroleum product and is the most commonly use fuel oxygenate. It belongs to a class of chemical compounds known as ethers and has been added to gasoline since 1979 to improve air quality by allowing gasoline to burn cleaner. More oxygen in gasoline results in more complete burning of fuel thereby reducing carbon monoxide emissions. EPA has tentatively classified MTBE as a possible human carcinogen.

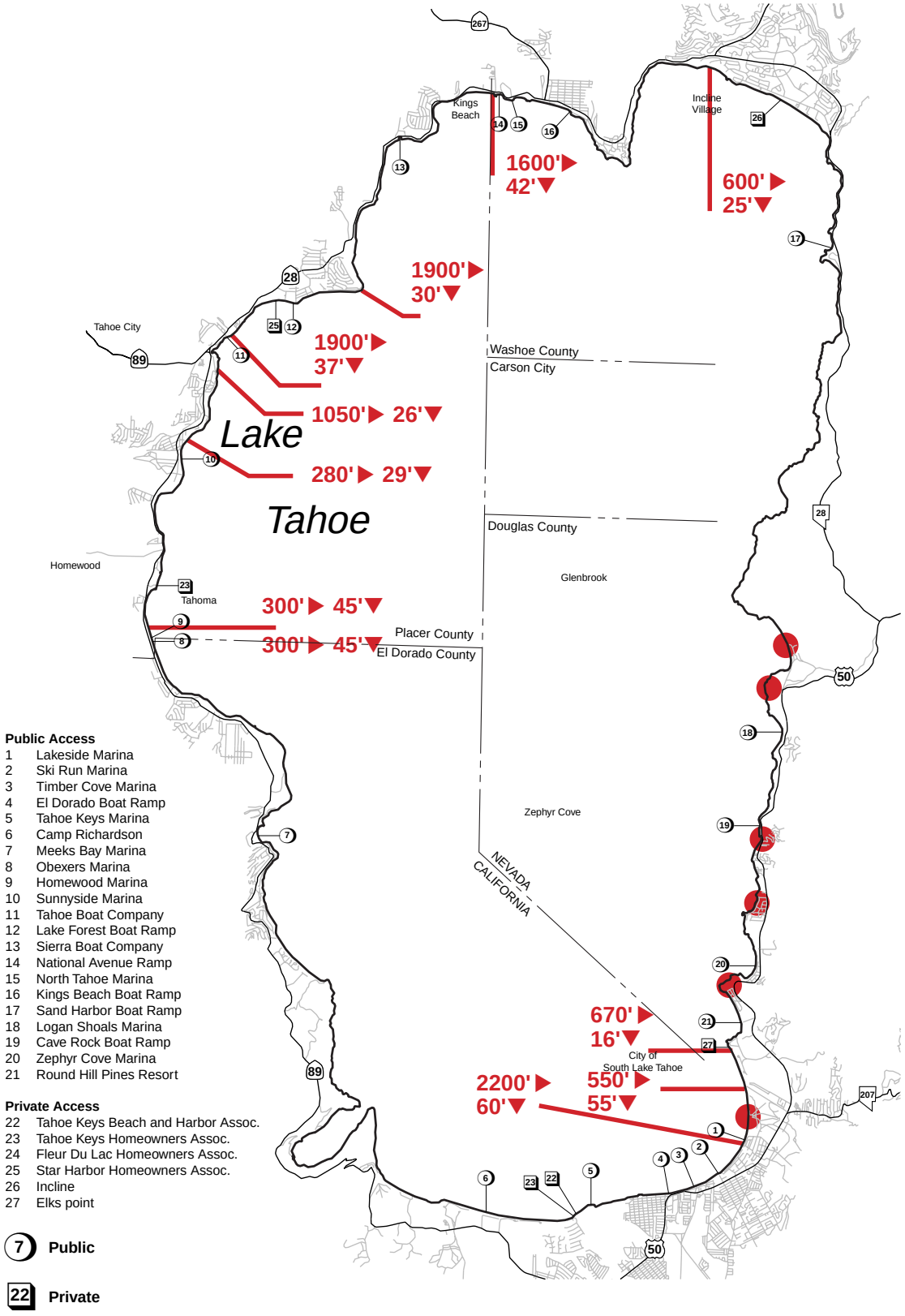
Human health effects associated with breathing or otherwise consuming MTBE for short periods of time are not known. Most studies have indicated that MTBE does not biodegrade easily under various environmental conditions. There are a number of point and non-point sources of MTBE which impact surface and groundwater quality. In addition to motorized watercraft, gasoline spills, leaking underground storage ranks, stormwater runoff, and even precipitation are potential sources of MTBE.

Recent studies indicate that the use of MTBE as gasoline additive is a problem. One concern with MTBE is its ability to leak from underground storage tanks or pipelines and rapidly pass through soil into groundwater, thus affecting drinking water supplies.

Concerns have also arisen with respect to motorized watercraft and MTBE. High levels of MTBE have been detected during the boating season. Water intake lines at Lake Tahoe have the same potential to be affected as do underground wells utilized for drinking water. Figure 3, Major Surface Water Intake Lines and Concentrated Boating Use Areas, below, shows the relationship between intake lines and potential “hotspots” of MTBE concentration due to operation of motorized watercraft.

As shown in Table 7, restrictions on the use of watercraft powered by two-stroke engines would reduce levels of MTBE over current levels. In addition, banning MTBE would be helpful in eliminating MTBE pollution; however, it would not fix the problem for the other pollutants. Although not part of this project, the removal/replacement of MTBE as a fuel additive is a recommended mitigation measure for that type of pollution.

Figure 3. Major Surface Water Intake Lines and Concentrated Boating Use Areas

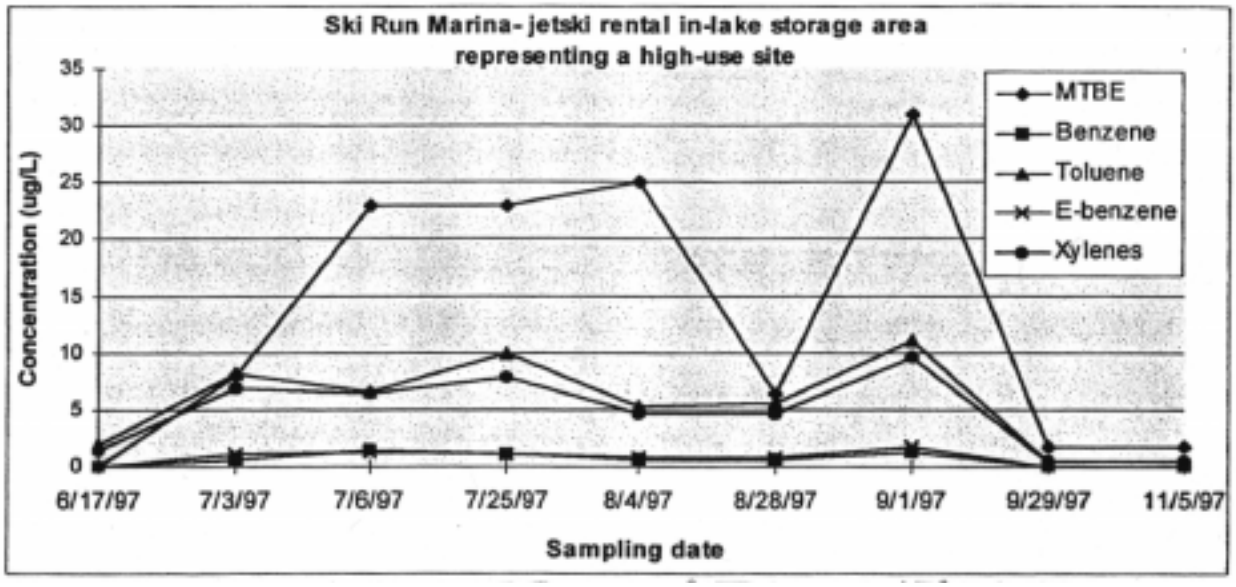


Concern over MTBE's effect on drinking water sources in the Region prompted the TRPA Governing Board to adopt RESOLUTION NO. 98-14, which recommends that the governor of California take action prohibiting the use of MTBE as a gasoline fuel oxygenate for California and the California portion of the Lake Tahoe Region.

***BTEX Compounds**:* The so-called BTEX compounds commonly found in gasoline include benzene, toluene, ethylbenzene, and xylene. They are the most commonly studied gasoline constituents with regards to gasoline contamination of the soil and water. Benzene is the most common indicator of gasoline presence. There are approximately 70 or more hydrocarbon constituents in gasoline, approximately 13 of which are benzene derivatives. Benzene will always be present in gasoline.

Table 7 above shows the relative toxicity levels for the BTEX series with respect to drinking water quality and toxicity to aquatic life. At 1ppb, benzene has the lowest concentration with respect to drinking water quality standards. With respect to acute lowest observable effect level of toxicity to aquatic life, benzene again has the lowest concentration with 5,300 ppb.

Figure 4. Ski Run Marina – 1997 Sampling Results



Source: Lake Tahoe Motorized Watercraft Report, Appendix 8.1

Table 8. Concentrations of BTEX Compounds and Oxygenates in Water Samples from Lake Tahoe and Other Sierra Nevada Lakes.

Site	Date	Time	Depth (meters)	Benzene	Toluene	Ethyl Benzene	o-Xylene	m- and p-Xylene	Xylenes (Total)	MTBE	ETBE	TAME
Lake Tahoe												
Chambers Lodge	8/12/98	1300	3	<0.1	0.27	E 0.039	E 0.071	0.19	E 0.26	0.78	<0.054	0.13
Edgewood	8/12/98	0900	3	.21	1.0	.18	.36	.94	1.3	2.4	<.054	.45
Emerald Bay	8/12/98	1410	3	.44	1.5	.20	.59	1.5	2.1	4.0	<.054	.85
Glenbrook Bay	8/11/98	1400	3	<.1	.27	E .059	.099	.26	.36	.47	<.054	<.11
Incline Beach	8/11/98	1230	3	.17	1.0	.24	.42	1.0	1.4	.84	<.054	.10
Kiva Beach	8/12/98	1500	3	.17	.78	.12	.23	.58	.81	1.8	<.054	.34
Tahoe City	8/12/98	1050	3	.11	.56	.097	.17	.44	.61	1.3	<.054	.15
Tahoe City	8/2/97	---	3	.33	<1.9	<.39	<.60	1.6	<2.2	4.2	<.054	.20
Tahoe Keys	8/12/98	1600	3	.18	.91	.17	.28	.72	1.0	2.0	<.054	.34
TRG Buoy	8/11/98	1030	3	<.1	E .08	<.03	<.064	<.064	<.064	.45	<.054	<.11
TRG Buoy	8/11/98	1050	30	<.1	<.054	<.03	<.064	<.064	<.064	.22	<.054	<.11
Zephyr Cove	8/11/98	1600	3	.61	4.4	1.1	2.0	4.7	6.7	1.3	<.054	.17
Other Sierra Nevada Lakes												
Upper Angora	8/13/98	1110	3	<.1	<.054	<.03	<.064	<.064	<.064	<.17	<.054	<.11
Upper Angora	8/13/98	1230	6	<.1	<.054	<.03	<.064	<.064	<.064	<.17	<.054	<.11
Lower Echo	8/10/98	1400	3	.40	3.5	.71	1.1	1.5	2.6	7.7	<.054	2.2
Fallen Leaf	8/10/98	1100	3	<.1	.11	<.03	<.064	E .075	E .075	.78	<.054	.14

Source: Lake Tahoe Motorized Watercraft Report, Appendices 8.3 & 8.4

Concentrations are in micrograms per liter

Abbreviations

<	**Less Than**
E	**Estimated Concentration**
BTEX	**Benzene, Toluene, Ethylbenzene, and Xylene**
ETBE	**ethyl-*tert*-butyl ether**
MTBE	**methyl-*tert*-butyl ether**
TAME	**tertiary-amyl-methyl ether**

Benzene as a Gasoline Loading Indicator: Benzene is a known carcinogen and is toxic at lower levels than toluene. There are approximately 70+ hydrocarbon constituents in gasoline, approximately 13 of which are benzene derivatives. The solubility of benzene is one of the highest of all the gasoline constituents at 1780 mg/L, vs 500 mg/L for toluene (MTBE = 50,000 mg/L). For the above reasons, benzene is a prime candidate for purposes of analyzing the impacts of gasoline loading by various types and numbers of watercraft engines.

The impacts of the various alternatives are discussed in section 3 below. However, neither the 1997 EA nor the information now available to TRPA indicates that restricting the use of watercraft powered by two-stroke engines will result in significant adverse water quality impacts.

Rather, the evidence demonstrates that it is the use of watercraft powered by two-stroke engines that has significant impacts on water quality in the Tahoe Basin. Thus, as demonstrated by Table 6, the use of motorized watercraft has caused at least one exceedence of water quality standards for BTEX and MTBE. In addition, in many areas, samples found levels of these pollutants that are very close to the established water quality standard and therefore unacceptable in view of TRPA's goal to reduce water pollution in Lake Tahoe. As demonstrated by Table 7, restricting the use of two-stroke engines would reduce the loadings of BTEX and MTBE in Lake Tahoe.

2.3 Air Quality Update

Environmental Setting and Introduction

The 1997 EA provides information regarding the air quality setting in Lake Tahoe. As discussed in sections 4.1 and 4.3 of the EA, the clean alpine air of the Tahoe Basin contributes to its uniqueness. Although sources of pollution, such as traffic and boating use, have increased since 1982 (when the environmental thresholds were adopted), the data summarized in the 1997 EA indicates that the Tahoe Basin is in attainment for the TRPA carbon monoxide standard, nutrient loading standard, and the federal ozone standard. Exceedences of the TRPA 1-hour ozone standard were recorded during 1995. TRPA's management standard for nutrient loading calls for a reduction in vehicle miles traveled (VMT) by 10 percent of 1981 values to reduce NOx pollution from automobiles. This standard is not in attainment.

As discussed in section 4.4 of the 1997 EA, the number of VMT in the Tahoe Basin increased since 1982. However, increases in emission control technology for automobiles has reduced the number of exceedences of air quality standards in the Tahoe Basin. Although automobile emission control technology has improved greatly, little progress had been made to reduce air pollution from motorized watercraft engines. As a result, motorized watercraft emit disproportionately higher amounts of carbon monoxide and NOx than do automobiles. However, the total daily percentage of air emissions from boats as compared to automobiles is small.

Sections 4.1, 4.3, and 4.4 of the 1997 EA are incorporated herein by reference.

Air Quality Evaluation Criteria

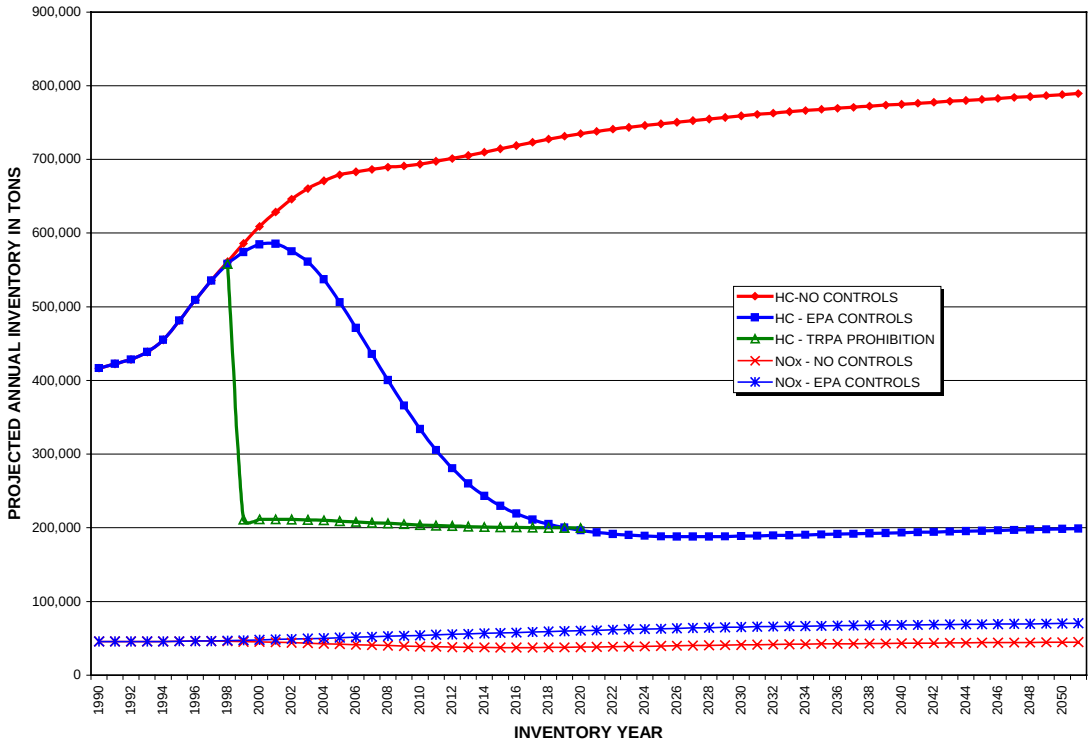
The impacts of restricting the use of watercraft powered by two-stroke engines will be considered significant if it will cause exceedences of the TRPA air quality thresholds or state or federal standards regulating air pollution. These standards are set forth in section 4.2 of the 1997 EA, which is incorporated herein by reference.

Air Quality Impacts

As set forth in the 1997 EA, restricting the use of watercraft powered by carbureted two-stroke engines is not expected to cause exceedences of TRPA, federal or state standards for hydrocarbons, carbon monoxide, or ozone. However, the 1997 EA did note the potential for increases in NOx production under both the No Project Alternative and Alternative 2, Ordinance 97-12. This potential increase was expected to occur whether or not Ordinance 97-12 was adopted. EPA regulations adopted in 1996 regulate air emissions from marine engines by requiring reductions in the combined amount of hydrocarbons and NOx emitted. As a result of these regulations, NOx emissions are expected to increase. NOx emissions were also projected to increase with the adoption of Ordinance 97-12 due to the switch over to four-stroke and fuel-injected engines.

Figure 5 is a figure developed by EPA and modified by TRPA that shows the projected emission inventories for spark ignition engines. Although NOx emissions are anticipated to increase with the reduction of hydrocarbons, this figure represents the relative magnitude of the increase. EPA developed this figure using nationwide numbers, and so the data may not exactly correspond to Tahoe's inventories. This information should be used to show the trend in marine emission inventories only and give a comparison for EPA and TRPA regulations.

Figure 5. U.S. EPA and TRPA Projected Emission Inventories for Spark Ignition Engines.



Revised Nox/Hydrocarbon loadings

TRPA has revised pollutant loading figures (see Table 9) to account for the updated fuel use figures developed for this EA. The emission factors utilized are found in Tables 4-6 and 4-7 of the original environmental assessment. The revised fuel use figures and the emission factors were used to estimate the pounds of various pollutants given the estimated mix of engines in use for 1998 and 2008. With or without the prohibition on watercraft powered by two-stroke engines, a general increase in boating activity by the year 2008 will result in a significant increase in NOx generation. As indicated in the 1997 EA, boating needs to be included in the TRPA Air Quality Mitigation Program; however, this program is not part of the current project which focuses on restricting watercraft use. As to the impact on NOx loadings because of the restrictions on the use of watercraft powered by two-stroke engines, see the NOx discussion below.

Table 9. TRPA Estimates of Air Pollutants per Pound - Boating Season (Alternative 1)

		1998 Pounds (lbs) of Pollutant per Year						2008 Pounds (lbs) of Pollutant per Year					
	Engine Type	**Fuel Use Season**	**TOG**	**NOx**	**CO**	**PM10**	**SOx**	**Fuel Use G/Hour**	**TOG**	**NOx**	**CO**	**PM1O**	**SOx**
Up to 10 hp	G2	5,476	11,344	45	8,918	580	10		0	0	0	0	0
10 to 30 hp	G2	5,512	9,040	105	17,286	584	10		0	0	0	0	0
Over 30 hp	G2	69,070	107,945	1,479	229,692	7,321	131		0	0	0	0	0
Private Watercraft													
Outboard Total	G2	80,055	134,848	1,457	234,348	8,486	152		0	0	0	0	0
Auxiliary Sail	G2	2,477	4,775	29	5,278	263	5		0	0	0	0	0
Outboard	G4/G2I	30,946	4,673	3,126	100,048	50	59	121,963	18,416	12,318	394,306	195	232
Inboard/Outboard	G4	847,229	127,932	85,570	2,739,091	1,356	1,610	971,226	146,655	98,094	3,139,974	1,554	1,845
Inboard	G4	467,833	70,643	47,251	1,512,504	749	889	537,487	81,161	54,286	1,737,695	860	1,021
Inboard Jet	G4	15,775	2,382	1,593	51,001	25	30	20,686	3,124	2,089	66,878	33	39
Auxiliary Sail	G4	929	140	94	3,003	1	2	4,150	627	419	13,417	7	8
Inboard	D	929	175	360	388	22	7	1,081	203	419	452	26	8
Auxiliary Sail	D	1,394	262	541	583	33	10	1,624	305	630	679	39	12
PWC	G2	87,872	194,197	1,125	354,124	9,314	167		0	0	0	0	0
PWC	G4/G2I		0	0	0	0	0	67,208	10,148	6,788	217,283	108	128
Total Watercraft Trips Input													
Total Watercraft Trips/Fuel Use		1,535,156						1,725,425					
Concessionaire Watercraft													
Two stroke	G2	105,550	183,340	1,864	320,619	11,188	201		0	0	0	0	0
Two stroke DFI	G2 DFI	6,854	1,035	692	22,159	11	13	93,965	14,189	9,490	303,789	150	179
Four Stroke	G4	108,648	16,406	10,973	351,259	174	206	141,205	21,322	14,262	456,516	226	268
Concession Input													
Concession Total		221,052	200,781	13,530	694,037	11,373	420	235,170	35,511	23,752	760,305	376	447
Total Motorized Watercraft		**1,756,208**	**876,211**	**156,386**	**5,963,830**	**40,615**	**3,510**	**1,960,595**	**296,150**	**198,796**	**6,330,989**	**3,198**	**3,739**

NOx: Besides the NOx increases due to additional boating, the conversion of two-stroke engines to more efficient direct injection or four-stroke models results in increased discharges of nitrous oxide to the air. NOx emissions from watercraft were studied by Dr. Tom Cahill and Dr. Steve Cliff of the University of California, Davis in collaboration with the Tahoe Research Group. The scope of the study was to evaluate whether the concern over NOx emissions as a result of engine technology conversion was reasonable. The analysis evaluated the magnitude of NO and/or NOx emissions to the atmosphere by comparison of the loads expected from a 4-cycle 9.9 hp outboard engine (3.9 g NOx per pound of fuel) versus that of a 2-cycle 9.9 hp outboard engine (1.0 g NOx per pound of fuel) to a "virtual atmosphere box."

The analysis concluded that the average increase in NOx emissions due to the conversion of old technology two-strokes was calculated at 0.0006% of the total NOx measured values. Therefore, the increase in NOx emissions to the air due to an engine conversion during 1998 (1988 boating data was utilized), is negligible and insignificant.

This environmental assessment evaluates the impacts of the various alternatives assuming that EPA and CARB standards are put into effect. Impacts are projected for the year 2008 because this time frame provides an opportunity for TRPA to evaluate the benefits of restricting the use of watercraft powered by two-stroke engines even though boating use in general is expected to increase at Lake Tahoe. In 1999, when the restrictions take effect, the immediate benefit for water quality will be even greater than demonstrated by the 2008 numbers. This benefit will occur because of a reduction in the number of watercraft powered by two-stroke engines on the Lake. To some extent, the water quality benefits will diminish over time as boating use increases; however, pollution levels will still decrease in most categories over 1998 conditions. Areas where pollutants do not decrease, such as NOx emissions, are not related specifically to the restrictions on watercraft powered by two-stroke engines, but instead result from an increase in boating generally. TRPA intends to address impacts related to increased boating at the Lake through the implementation of a NOx mitigation fee, a program to implement boating and fueling BMPs, regulations limiting the use of motorized watercraft, and the eventual elimination of MTBE as a fuel additive.

2.4 Biological Update

The 1997 EA analyzed the impacts of restricting the use of motorized watercraft on fisheries and wildlife. This analysis noted that there are impacts to fisheries and wildlife from watercraft usage in general, which include noise impacts, and disturbance of fish breeding grounds and bird nesting areas. The 1997 EA also concluded that restricting the use of watercraft powered by two-stroke engines would reduce impacts to these resources. The analysis contained in Chapter 9 of the 1997 EA is incorporated herein by reference.

Studies regarding the impacts of oil and gas discharged from motorized watercraft on the aquatic environment are inconclusive and contradictory. One study found that only 0.03 parts per million of oil contamination reduces food absorption, stunts growth, and kills certain species. In contrast, as study conducted for Kiekaefer Mercury (a marine engine manufacturer) revealed no evidence of contamination by hydrocarbons found in exhaust water. Additional studies of the water and sediment showed that phytoplankton and bottom organisms were not affected by hydrocarbon emissions. Another study concluded that the cumulative effects on the ecosystem are not known (Nelson, 1994). Although the toxicity of the oil and gasoline mixture burned by outboard engines appears to be low, the combustion process can potentially lead to the formation of polycyclic aromatic hydrocarbons (PAHs, discussed below), which are known to be

carcinogenic and mutagenic. Concern over their potential impacts prompted Switzerland and Austria, which border on Lake Constance, to adopt regulations for marine engines. Lake Constance is therefore the first body of water to be protected from the impacts of PAH emissions from motorized watercraft.

Although the 1997 EA concluded that restricting two-stroke engines would not adversely impact biological resources, it also noted the need to better quantify the impacts of the use of watercraft powered by two-stroke engines in the Tahoe Basin. Thus, the 1997 EA recommended additional studies on the impacts of hydrocarbon emissions, particularly emissions of polycyclic aromatic hydrocarbons, from motorized watercraft. Additional studies of this issue are underway and the status of this research is summarized below.

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs): PAHs are organic compounds that resemble benzene in chemical behavior, which contain more than one benzene ring (poly-cyclic). A single benzene ring is composed of 6 carbon atoms and 6 hydrogen atoms. There are many forms of PAHs. The simplest form of PAH is naphthalene, which consists of two benzene rings. PAHs are found in gasoline, asphalt, coal tar, and creosote. They also form from the incomplete combustion of fossil fuels. Approximately 30 percent of the compounds found in gasoline are characterized as PAHs.

When released to water, PAHs are not subject to rapid volatilization under common environmental conditions. They have low aqueous solubility values and tend to strongly adsorb to soils and sediments and remain fixed in the environment. PAHs with more than three rings generally have poor biodegradability characteristics and tend to bioaccumulate.

PAHs can remain in a micro-layer on the surface of the water, which is a breeding ground for small organisms that form the base for aquatic food chains (Widdows et al). Moreover, petroleum products containing PAH's accumulate in the surface waters and terrestrial interface (shoreline) of both fresh and saltwater environments. Unfortunately, these same locations are where fish spawning activities occur and are used as nurseries for developing fish.

Most studies conducted on PAH's have been in saltwater environments and relate to specific oil spill events, not emissions from watercrafts. Little information existed on freshwater environments, until completion of a study by James T. Oris in Lake Tahoe.

Oris and colleagues conducted a series of experiments to assess the potential toxic impacts of ambient levels of motorized watercraft emissions in Lake Tahoe on zooplankton and fish larvae (Oris et al, 1997). Standard USEPA effluent toxicity testing using zooplankton (*Ceriodaphnia dubia*) and fish larvae (*Pimephales promelas*) was completed utilizing Lake Tahoe water impacted by motorized watercraft emissions. There was sufficient concentrations of PAHs present to cause measurable, negative impacts on fish larvae growth and on zooplankton survival and reproduction.

The Lake Tahoe Motorized Watercraft Report (1998) states that additional PAH studies are essential to understanding their impact on biota of Lake Tahoe. With respect to PAHs, the water quality benefits as a result of converting two-stroke engines to direct fuel injection and/or four-stroke type engines are not fully understood. Most PAHs present in gasoline are transformed into non-PAH by-products during the combustion process in a four-stroke engine. However, also being of pyrolitic origin (products of combustion) as well as constituents of raw fuel, conversion to engines which more (or less) completely burn PAHs may produce new, pyrolitic PAHs.

In view of the current status of the research, it is unclear whether the conversion from watercraft powered by carbureted two-stroke engines to those powered by direct injection engines will benefit water quality by reducing PAH emissions. Reductions in PAH emissions may not be as great as reductions in MTBE, Benzene, and Toluene emissions. Although direct fuel injection engines inject fuel into the combustion chamber, lubricating oil is still introduced to the engine's moving parts via the crankcase; therefore, oil exhaust port blow-by still occurs and remains a potentially significant source of PAHs. Because this blow-by occurs with both carbureted and direct injection two-stroke engines, the restrictions on carbureted two-stroke watercraft are not expected to result in increased PAH production. In addition, direct fuel injected engines produce greater quantities of particulate matter than do four-stroke engines. PAHs may attach to this particulate matter and be emitted into the air. However, direct injection engines do not produce more particulate matter than do carbureted two-stroke engines. Thus, the restrictions of watercraft powered by carbureted two-stroke engines are not expected to increase particulate matter or PAH production at Lake Tahoe. Additional studies are recommended to evaluate the relationship between the use of motorized watercraft in general and PAH production.

2.5 Recreation Update

The 1997 EA provides an introduction and background to recreational issues at Lake Tahoe at pages 6-1 through 6-4, which are hereby incorporated by reference.

Evaluation Criteria.

TRPA's Goals and Policies include a recreation element as part of the Regional Plan. The Regional Plan incorporates the relevant environmental threshold and states:

> *It shall be the policy of the TRPA Governing Body in development of the Regional Plan to preserve and enhance the high quality recreational experience including preservation of high-quality undeveloped shorezone and natural areas. In developing the Regional Plan, the staff and Governing Body shall consider provisions for additional access, where lawful and feasible to the shorezone and high quality undeveloped areas for low density recreational uses.*
>
> *It shall further be the policy of the TRPA Governing Body in the development of the Regional Plan to establish and insure a fair share of the total Basin capacity for outdoor recreation is available to the general public.*

The 1997 EA discusses TRPA's efforts to attain these environmental thresholds. This discussion, contained at pages 6-5 and 6-6 of the 1997 EA, indicates that TRPA is in attainment with its interim goals to meet these thresholds and is hereby incorporated by reference.

Impacts of Proposed Restrictions on Watercraft Powered by Two-stroke Engines.

TRPA will consider the impacts of a proposed alternative to be significant if it substantially interferes with attainment of these environmental thresholds for recreation.

Recent survey information completed by Hagler Bailly at Lake Tahoe helps clarify the anticipated impacts. The survey information supports the original assumption that most boaters

will comply with the ordinance. The impacts on overall boating are a concern. It was the assumption of the 1997 EA that there would be a significant reduction in use for private PWCs for several years, but would climb back to 1997 levels as soon as the watercraft became available. The two-year amortization/education period was added to the 1997 ordinance to mitigate these impacts. The 1997 and the 1999 analyses assume that by 2008 boating would be back to normal using the better technology watercraft.

However, a temporary reduction in the number of jet skis and other watercraft powered by two-stroke engines does not interfere with the environmental thresholds described above. TRPA's goal as embodied in the thresholds is to provide for a high quality recreational experience that is accessible to the general public. Conflicts among recreational users diminish this experience at Lake Tahoe. Evidence presented to TRPA during its consideration of Ordinance 97-12 strongly indicated that there is a growing conflict between users of personal watercraft and passive recreational users of Lake Tahoe. This discussion is contained at pages 6-10 & 6-11 of the 1997 EA and hereby incorporated by reference. In particular, people cited noise complaints and disruption of wildlife as key impacts associated with the use of personal watercraft. Discussion of noise impacts on people and wildlife is contained in the 1997 EA at pages 5-7 and 5-12 & 5-13 and is hereby incorporated by reference.

In addition, evidence demonstrates that two-stroke engines discharge disproportionate amounts of their fuel unburned directly into the water. This disproportionate level of pollution is not compatible with providing a high quality experience of the Lake Tahoe environment. Moreover, restricting this form of highly polluting boating activity does not interfere with other types of recreational uses, including the use of other less polluting motorized watercraft, swimming, hiking, beach use, and the use of non-motorized watercraft, such as canoes or kayaks.

The survey information (Table 10) from a boat ramp/marina sample and from a property owner sample demonstrates that the boating public is well aware of the June 1, 1999 prohibition. As to a reduction in boating, 19% of the boaters using marina and boat ramp facilities indicated they would stop boating on Lake Tahoe; however, only 1% percent of the property owners would stop boating. It appears that most boaters are aware of the prohibition and will comply.

Table 10. Anticipated Impact of the June 1999 Ban on Carbureted Two-Stroke Motors on Lakes of Tahoe on Boaters' Activities

	Boat Ramp/ Marina Sample[a] (n = 554)	Property Owner Sample[b] (n = 97)
Percent of Boaters who:		
◆ Heard of proposal	77%	93%
◆ Did not hear of proposal	23%	7%
TOTAL	100%	100%
Percent of All Boaters Who Anticipate the Ban will Cause Them To[c]:		
◆ Stop boating on Lake Tahoe	19%	1%
◆ Continue to boat and purchase a new motor that complies	9%	18%
◆ Continue to use existing motor	23%	43%
< currently have a complying motor	97%	
< currently have a non-complying motor	3%	
◆ Decrease the number of days spent boating on Lake Tahoe	3%	3%
◆ Boat about the same number of days on Lake Tahoe	55%	37%
◆ Increase the number of days spent boating on Lake Tahoe	5%	3%
◆ Other	8%	9%
◆ Currently do not boat	NA	14%

[a] Percent of boat ramp/marina sample from the intercept survey.
[b] Percent of property owner sample from the mail survey.
[c] Percent of all respondents, not limited to those who had heard about the ban prior to the survey.

2.6 Other Impacts Determined Not to Be Significant

Noise Impacts

The 1997 EA concluded that there were would be no noise impacts associated with restricting the use of watercraft powered by two-stroke engines. The 1997 EA determined that the use of personal watercraft in particular created noise levels that are unacceptable to some people using the Lake for other types of recreation such as beach-going. Moreover, the types of noise produced by personal watercraft were found to be detrimental to wildlife. Therefore, TRPA proposed and adopted a 600 foot no wake zone to reduce noise impacts to on-shore users and wildlife. TRPA does not propose altering the no wake zone, and nothing in the proposed alternatives would affect the noise impacts from the use of motorized watercraft. In fact, if

restrictions on the use of two-stroke engines reduces the number of personal watercraft on the Lake, noise levels should decrease. The analysis contained in Chapter 5 of the 1997 EA is incorporated herein by reference.

Boating Safety

None of the proposed alternatives are expected to have any significant impacts on boating safety. The 1997 EA discussed issues related to boating safety and determined that, due to increases in watercraft use generally, the number of boating accidents was also expected to increase. Restrictions on the use of watercraft powered by carbureted two-stroke engines is not expected to increase boating activity. If anything, the proposed restrictions will, at least in the short-term, reduce watercraft use, especially the use of personal watercraft. Therefore, none of the proposed alternatives are expected to increase boating accidents, and their impacts on boating safety are insignificant.

3.0 Alternative Assessment:

3.1 Alternative 1: No Project – June 1997 Prohibition in Effect

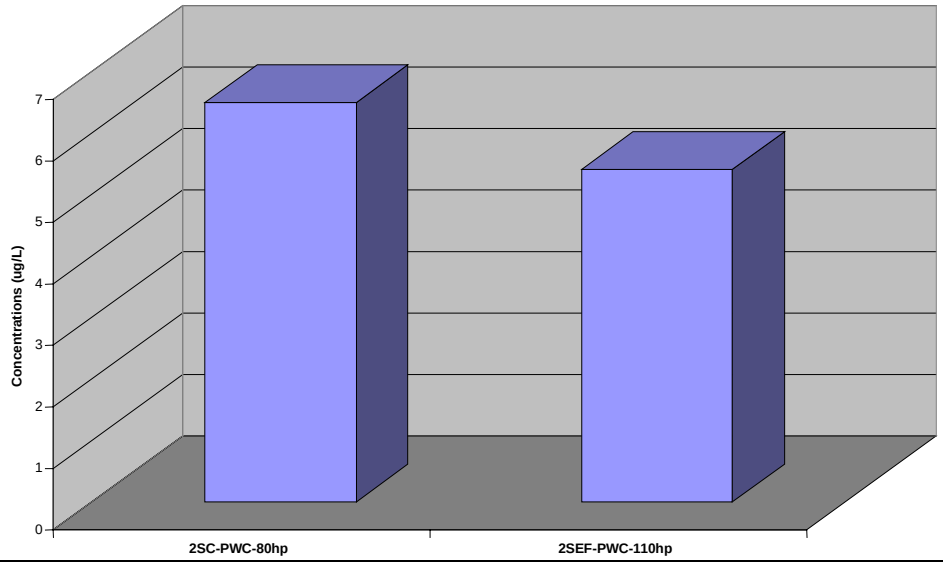
This alternative proposes to maintain the existing TRPA ordinance language which prohibits carbureted two-stroke engines on June 1, 1999. TRPA has reviewed the findings and data of the *Report* and this EA. A review of the evidence confirms that the 1997 action was correct based on the facts that:

- Discharge of Petroleum Products Occurs from Boating - Petroleum products are found in the lakes of the Region where motorized watercraft operate. The discharge of the pollutants occurs during the boating season and dissipates to a less than detectable level in the winter. The problem areas are in the shallow high boating use areas during the summer.

- Old Technology Two-Strokes are a Major Source of Discharge - The old technology, two-stroke watercraft (fuel charged, crankcase scavenged two-stroke engines) discharge an order of magnitude more pollutants than do the four-strokes or the direct injected two-strokes.

It has been recognized that the language of the existing ordinance contains a technical "loop hole" which would allow the legal operation of electronically injected two-stroke engines after June 1, 1999. The footnote in the 1997 EA notes: "The focus of the regulation is on all charged crankcase scavenged two-stroke engines; however, for regulatory reasons TRPA is limiting the ban on carbureted two-stroke engines." Engines, which electronically inject fuel into the crankcase prior to delivery to the combustion cylinder, still allow blow-by of fuel past the exhaust port. While these engines are slightly more efficient than their carbureted counterparts, their efficiency is not near that of direct injection and four-stroke engines. Figure 4 demonstrates that EFI technology is similar to the carbureted technology based on in lake testing. Alternative 2 addresses this issue.

Figure 6. In-Lake Experiment: Comparison of Two-Stroke Personal Watercraft Engine Efficiencies – Dissolved Toluene Exhausted for Four Pass Treatment at Operating Speed.



Water Quality Impacts: Maintaining the existing prohibition on carbureted two-stroke powered watercraft does not have a water quality impact since the measure will significantly reduce water quality impacts over existing environmental conditions when it goes into effect June 1, 1999. However, analysis indicates the opportunity exists to further reduce discharges consistent with the TRPA's original goal to reduce the discharge from old technology two-stroke powered watercraft. This issue is addressed in Alternative 2.

Air Quality Impacts: Maintaining the existing prohibition on carbureted two-stroke powered watercraft will not adversely affect air quality. When the prohibition goes into effect hydrocarbon emissions will be significantly reduced and, as discussed in Section 2.3, NOx emissions will not change significantly.

Recreation Impacts: Maintaining the existing prohibition on carbureted two-stroke powered watercraft does not have a significant recreation impact since it will not conflict with the recreation thresholds as discussed in Section 2.5 above.

Mitigation Measures: There is no mitigation required from the no action alternative; however, as the analysis points out, there is an opportunity to improve the 1997 action which is described in Alternative 2 below.

3.2 Alternative 2: Proposed Action

The proposed action alternative that includes the ordinance language to improve and clarify the 1997 action prohibiting carbureted two-strokes commencing June 1, 1999. The Governing Board has requested consideration of the following action items:

Goals and Policies Amendment Regarding Motorized Watercraft – TRPA legal counsel has suggested that the action to prohibit carbureted two-strokes found in the Code should flow more directly from the language in the Goals and Policies. This is considered to be a technical supporting modification that has no impact on the substance of the TRPA prohibition. Based on APC and Governing Board input in November, the language has been modified and included in the recommended actions.

Criteria for Identifying Prohibited Watercraft – TRPA's current ordinance bans the discharge of unburned fuel and oil from the operation of carbureted two-stroke engines starting June 1, 1999. This ban was adopted in response to evidence that carbureted two-stroke engines discharge as much as 25% of their fuel directly into the air and waters where they operate. TRPA's goal in adopting this ordinance is to prevent the use of watercraft that discharge disproportionate amounts of their fuel into the waters of the Tahoe Basin.

As discussed in Alternative 1 above, TRPA's carbureted two-stroke prohibition permits the use of electronic fuel injection two-stroke engines that also discharge significant amounts of their unburned fuel. Thus, TRPA recommends changing the current ordinance to prohibit the use of all watercraft powered by fuel charged crankcases scavenged two-stroke engines or, in laymen's terms, carbureted and electronic fuel injection two-stroke engines. The Governing Board recommends the consideration of a three-year time extension for those who purchased a new watercraft or engine that meets the current ordinance, but that would be prohibited by the more inclusive language of the proposed amendment.

Water Quality Impacts: Maintaining the existing prohibition on carbureted two-stroke powered watercraft with the addition of EFI equipped two-stroke watercraft for three years does not have a water quality impact since the measure will significantly reduce watercraft emissions overall once the measure goes into effect. Pursuant to the discussion in Alternative 1 above, TRPA has quantified discharges by EFI two-stroke engines based on 1998 boating activity. Based on the 1997 assumption that four-stroke and DFI technology was the acceptable clean technology for the near future, it does not appear that EFI technology is an acceptable clean technology. It is TRPA's conclusion that EFI technology is similar to carbureted technology. This assumption is further confirmed by a review of CARB and EPA data that indicates these watercraft would not be certified as meeting the CARB 2001 standard.

With respect to EFI equipped two-stroke discharges, Table 11 shows the calculated loads of unburned gasoline and gasoline constituents based on levels of boating activity in year 1998. It is assumed that 10% of the two-stroke engines are equipped with electronic fuel injection. This estimate is based on production information obtained from Mercury Marine, sales information from local marine retailers, and estimates of EFI use at a Lake Tahoe marina. EFI equipped two-stroke engines were first marketed in the early 1980's. Their advantage over carbureted engines is primarily ease of starting and overall operating performance. Tahoe Keys Marina estimated that up to 40% of the vessels operating in the marina are equipped with EFI in order to take advantage of the greater performance at Lake Tahoe's high altitude. (Motorized watercraft within this marina represent the higher horsepower range.) A Reno marine retailer, however, estimated that EFI equipped two-stroke engines comprised less than 5% of the two-stroke fleet, as most of the engines sold are small fishing engines or engines in the 40 to 75 horsepower range, which typically are not equipped with EFI. The number of after-market bolt-on EFI kits sold and installed to convert to EFI systems is not known at this time.

EPA estimates that EFI equipped engines are 15-24 percent cleaner than carbureted engines, based on percent reduction of hydrocarbons emitted (EPA Regulatory Impact Analysis, 1996). In comparison, four-stroke engines are 75-95 percent cleaner (with respect to hydrocarbon emissions) than carbureted two-strokes, and direct injection two-strokes are 75-90 percent cleaner. In general, EFI equipped two-stroke engines provide greater starting and operating performance, but remain within the same range of discharges as carbureted two-stroke engines.

Alternative 2 eliminates the use of EFI equipped two-stroke engines commencing October 1, 2001. Therefore the water quality benefits of Alternatives 1 and 2 would be the same through the next three seasons when compared to existing environmental conditions. After October 1, 2001, Alternative 2 will provide additional environmental benefits by eliminating discharges from EFI watercraft. The seasonal loads from EFI equipped two-stroke engines are estimated below.

Table 11. Estimate of Unburned Soluble Fuel, MTBE, Benzene and Toluene Discharge by EFI Equipped Two-Stoke Engine Type and Gallons of Gasoline Used, 1998 Boating Season.

‘		Soluble Fuel	MTBE	Benzene	Toluene
	Fuel Used Gallons	Discharged Gallons	Discharged Gallons	Discharged Gallons	Discharged Gallons
EFI Equipped Two-Stroke OB:	11,348	685	492	19.7	112
All Motorized Watercraft:	1,756,491	42,378	9,918	597	3,009
Percent of Total:	0.64%	1.62%	4.96%	3.30%	3.72%

Assumes 10% of two-stroke OB fleet equipped with EFI

Assumes EFI equipped two-stroke 20 percent more efficient combustion than carbureted two-strokes.

Air Quality Impacts: The proposed modifications to the existing prohibition on carbureted two-stroke powered watercraft will not adversely affect air quality impact. When the prohibition goes into effect, hydrocarbon emissions will be significantly reduced and, as discussed in Section 2.3, NOx emissions will not change significantly.

Recreation Impacts: The proposed modifications to the existing prohibition on carbureted two-stroke powered watercraft does not have a significant recreation impact since it does not conflict with the recreation thresholds as discussed in Section 2.5 above.

Mitigation Measures: There is no mitigation required from the proposed action alternative.

3.3 Alternative 3: Alternative 2, with Exemptions:

Alternative 3 is identical to Alternative 2, but includes consideration of exemptions to the June 1, 1999 prohibition of carbureted two-stroke powered watercraft as described below. Some Governing Board members, the plaintiffs in the watercraft lawsuit, some boating agency representatives, and some members of the general public, have raised the issue of exemptions. Generally, the issues are the cost to change engines, the unavailability of new engines, and the possibility of an insignificant impact from a selected group.

First, as to the availability of the new technology engines (e.g., four-strokes and direct injection two-strokes), review of the Technical Feasibility Section of the October 23, 1998 CARB Staff Report demonstrates the wide range of outboards available. As to PWCs, it appears that the direct injection Polaris Genesis model and the Tigershark TS1100Li model will be available this summer.

The fundamental problem is the conversion cost which can range between $500 for a small, used outboard to $10,000+ for a new, large outboard or PWC. To mitigate this impact, TRPA gave boaters two seasons to amortize and convert to the new technology.

The second issue relates to small horsepower engines and auxiliary engines that use only small amounts of fuel. Based on the incomplete surveys of the 1998 Hagler Bailly Watercraft Survey and some factors from the June 1997 TRPA Motorized Watercraft Environmental Assessment, TRPA staff has attempted to present an estimate of 1998 boating usage by watercraft type. In general, the new information indicates that the use of outboards is less at Lake Tahoe than was

previously estimated. The boating numbers from the survey are still being compiled and may need further adjustment; however, these estimates are adequate for analytical purposes. TRPA considered the following categories for three-year extensions from the prohibition.

Under 10 hp two-stroke carbureted outboard motors – Staff estimates that under 10 hp outboard two-strokes accounted for 1.59% of the seasonal boating use in 1998 and used 0.3% (5476 gallons) of the boating season fuel. However, as one can observe in Table 4, these engines account for 1.2% of the unburned soluble fuel discharged into the Lake. They are much less efficient on a horsepower basis than the larger motors and an order of magnitude more polluting than four-strokes. They result in 4.49% (247 gallons) of the MTBE discharged into the Lake. Also, these engines cost much less than the larger engines to replace. The significant contribution of pollutants and the low cost of engine replacement make it difficult to recommend exemption.

Auxiliary Two-Stroke Carbureted Outboards for Sailboats - Staff estimates that auxiliary outboard two-strokes for sailboats accounted for 1.6% of the seasonal boating in 1998 and used 0.016% (2477 gallons) of the fuel boating season fuel. The unburned soluble fuel discharge to the Lake is 0.5%. The hours of operation are much shorter. Although sailboats discharge one-half the amount of small outboards, the arguments regarding greater pollutant discharge per horsepower and less cost for small outboards apply here. Because of the previous two-year amortization period and the need for consistency in regulation, TRPA is not recommending pursuing these types of exemptions.

Fire Protection Boats – The APC recommended this in response to public testimony. At this point it would apply to one boat at Fallen Leaf Lake and the discharges could be considered insignificant. The Governing Board did not accept this recommendation based primarily on the belief that public agencies should set the example.

Exemptions for Certified Engines: This proposal has been discussed to provide the opportunity for all qualifying clean technology engines to be used in the Region. Currently direct fuel injection two-stroke engines are exempted. During the past year, CARB also has developed and implemented a set of standards for regulating the sale of marine engines based on their air quality and water quality impacts. Basically, CARB's prohibition on the sale of all engines that do not qualify for a 2001 Tier 1 certification approximates TRPA's prohibition on two-stroke engines (except DFI two-stroke engines). The CARB standard also reflects EPA's 2006 standard for marine engines. As part of its program, CARB is proposing a "sticker" program that will identify marine engines that comply with the CARB restrictions. It is TRPA's assumption that engines bearing a CARB 2001 sticker would comply with TRPA's prohibition. In general, any watercraft powered by a two-stroke engine whose engine is certified by the Environmental Protection Agency as meeting the U.S. EPA 2006 standard or is certified by the California Air Resources Board as meeting the CARB 2001 standard could be exempted from TRPA's prohibition. This exception would have no effect on discharge loading. It would provide program flexibility and coordination and would assist in providing more recreational opportunities.

Water Quality Impacts: With respect to discharge loads, Table 8 shows the calculated loads of gasoline constituents based on levels of boating activity in year 1998 for the two small engine exemptions. The addition of one or both of these exemptions is a significant deviation from the current standard that prohibits discharge commencing June 1, 1999. The fire boat exemption and the certified engine exemptions would not be measurable within the limits of this analysis

and would be considered an insignificant impact. The result of the exemptions would be three additional years of discharge.

Table 12. Summary of MTBE, Benzene and Toluene Discharge by Engine Type and Gallons of Gasoline Used Private Watercraft, 1998 Boating Season.

	Boat Trips	Fuel Used Gallons	MTBE Gallons	Benzene	Toluene
	Number & Percent	Number & Percent	Discharged	Discharged	Discharged
Two-Stroke Under 10 hp Outboards	2634	5476	237	9.5	53.9
	1.59%	0.35%	4.48%	2.36%	2.78%
Two-Stroke Aux. Sailboats	2641	2477	107.5	4.3	24.4
	1.60%	0.16%	2.03%	1.07%	1.26%

Assumes 7,991 gallons of gas are used by G2 outboards, 10 hp or less, versus G4 outboards, 10 hp or less.

Air Quality Impacts: The air quality impacts would be similar to the water quality impacts.

Recreation Impacts: Permitting the exceptions, except for the fireboat, may result in a short-term increase in the number of boats operation on the Lake. The fire boat exemption has no impact on recreational boating.

Mitigation Measures: The fire exemption and the certified engine exemptions require no mitigation. The small engine exemptions are required to reduce impacts to water quality to less than significant levels for the three year exemption period by:

- TRPA providing a three-year program to offset the three-year discharges such as prohibiting electronic fuel injected powered watercraft during this period.
- TRPA enforcing restricted access of other watercraft during the period to offset the three year discharges.
- TRPA and other agencies improve the level the enforcement to reduce fuel spills and reduce the use of unauthorized watercraft.

4.0 References

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4.5 GLOSSARY

Ambient standard - in-lake standard.

Backshore - an area where the water at high elevation meets the land.

Backwash - the return flow of water originating from the breaking of waves or swash.

Benthic - refers to the bottom of a body of water.

Bilge water - water which has collected in the lowest part of a boat. It often becomes contaminated with engine oils and other petroleum by-products from boat engines.

BMP - best management practice - any practice proven effective in erosion control or management of surface runoff.

Boat ramp apron - the most lakeward portion of a boat ramp.

Boat slip - a boat mooring, usually consisting of a floating dock which allows boaters direct access to land.

Breaker height - height of a breaking wave.

Breakwater - a structure located in a lake, designed primarily to protect shores from the effects of current or wave action. They are usually linear structures oriented parallel to the shoreline. They may be composed of boulders, sheet piling, or rock rib structures.

BTEX – Benzene, toluene, ethylbenzene, and xylene

Bulkhead - a retaining structure, usually vertical, which separates lake waters from the land.

Buoy - a float on top of the water which is held in place by an anchor located on the bottom of a body of water.

Catwalk - a narrow structure that is part of pier and which provides access to and from a pier.

Channelization - creation of an artificial straight body of water.

Cross member - structural component of a pier which usually connects two pilings.

Cultural eutrophication - the accelerated discharge of nutrients to water resulting from human activity.

Density current - a current caused by the influx of denser water as a result of its cooler temperature or sediment load.

Disturbance zone - a delineated area in which human activities may be restricted to prevent disturbance to nesting wildlife.

Dredging - removing or rearranging soil components on the bottom of a water body or which are located lakeward of the high water line.

Earthen bank - a linear, compacted soil structure designed to contain or separate flood waters from the land.

Endemic - prevalent in, or peculiar to, a particular locale or region.

Eulittoral "splash" zone - that area of Lake Tahoe's shoreline between the high and low annual water level of the lake.

Eutrophication - the discharge of nutrients to waters resulting from natural or human activities (See "cultural eutrophication").

Fetch length - the length of uninterrupted contact of the wind with a lake's surface. The greater the fetch length, the greater the wave energy produced.

Foreshore - an area of lake level fluctuation located between the high and low water lines.

Fry - fish hatchlings.

Game fish - fish typically caught for sporting pleasure.

Governing Board permit - a TRPA permit requiring review and approval from the TRPA Governing Board.

Groin - a structure that is similar to jetties but smaller. They are located in a lake, perpendicular to the shoreline. They may be composed of short sections of sheet piling, wood piling, or concrete.

Holding tank - a tank which is used for temporary storage and must be periodically emptied. On boats, they are used to temporarily contain human bodily waste.

Influence zone - a delineated area in which human activities may be restricted to prevent disturbance to the foraging habits of wildlife.

In-kind restoration or mitigation - restoration or mitigation which is of the same type (e.g., structure or capability district) as that which will be impacted.

Inlake relief - steep lake bottom topography.

Instability - area where the water meets the land.

Interstitial water - water located in lake bottom sediments, often referred to as "pore" water.

Jetty - a structure located in a water body, designed primarily to protect shores from the effects of current or wave action. They are usually linear in nature and oriented perpendicular to the shoreline. They may be composed of boulders, sheet piling, or rock crib structures.

Lake Tahoe Datum - the elevation of Lake Tahoe as reported by the United States Geological Survey, plus 1.14 feet.

Littoral parcel - a parcel of land next to the high water elevation of a lake.

Littoral processes - those processes along the shoreline of a body of water which affect and determine the shape of the shoreline. These processes include wind and wave action, current action, accumulation of solid material, and removal of solid material.

Littoral zone - an area around a lake's perimeter which extends lakeward for some specified distance. In Lake Tahoe, the distance is 100 meters.

Mooring - a fixed object to which a boat is attached.

Mooring buoy - a mooring device consisting of a heavy anchor, anchor line or chain, and float, to which a boat is attached.

MTBE – Methyl-Tertiary-Butyl Ether

Nearshore - an area extending from the low water elevation of a lake to some specified distance away from the shoreline. In Lake Tahoe the distance is 350 feet.

Non-game fish - all fish that are not considered sporting fish.

Oligotrophic - containing low concentrations of nutrients to support the growth of algae. An oligotrophic lake is regarded as having high water clarity due to the absence of significant amounts of algae.

PAH – Polycyclic aromatic hydrocarbons

PAOT - person at one time.

Pelagic - refers to the deepest parts of a body of water. In Lake Tahoe, it specifically refers to those waters below 100 meters.

Periphyton - algae that is attached to fixed structures in the water (e.g., rocks, piers, buoys).

Phytoplankton - algae that is free floating.

Pier - fixed or floating platform or structure extending from the back shore to beyond the high water elevation of a lake.

Pile pier - a pier whose main structural component consists of vertical wooden or steel pilings.

Primary productivity - a measure of how rapidly an algal population is growing.

PWC – Personal Watercraft

Qualified exempt activity declaration - a declaration made by the person responsible for the activity which does not require a TRPA permit. Retaining wall - a vertical structure which retains material behind it.

Revetment - a sloped, permeable structure, usually constructed of rock, which protects the shoreline from the effects of currents or waves.

Rip current - current created by the concentrated force of backwash.

Rock crib structure - an enclosure of wood, steel, or other material containing unconsolidated rock.

Rock crib pier - a pier whose main structural component is a rock crib structure.

Rode length - the length of the line connecting an anchor directly to a boat or buoy.

Seawall - a vertical device which protects the shoreline from waves or currents.

Secci disk - a disk, similar in size and shape to a dinner plate, with white markings used to determine the transparency of water. It is usually measured as the maximum depth at which the disk may be seen by the naked eye.

Settling velocity - the speed at which a particle drops through water and settles on the water's bottom. In general, larger particles have faster settling velocities than smaller particles.

Shoaling - temporary accumulation of lake bottom material due to storm action. Shoals may create a navigational hazard.

Sheet piling - heavy gauge sheets of steel which are driven vertically into the lake bottom.

Shoreline - the highest line normally covered by the waters of a lake or some other water body.

Shorezone - the area including the nearshore, foreshore, and backshore of a body of water.

SEZ - stream environment zone - an area which owes its physical and biological characteristics to the presence of surface or groundwater.

Spawning habitat - an area that attracts, or is capable of attracting, fish for reasons of producing and fertilizing eggs. Spawning areas are typically comprised of rock, cobble, or rubble.

Staff level permit - a TRPA permit approved at the staff level which does not require TRPA Governing Board review.

Sublittoral zone - the area which extends from just below the eulittoral zone to the bottom of the lake.

Superstructure - a structure within the foreshore or nearshore, other than a handrail, davit (hoist which is used to bring a sailboat from the pier deck to the lake), or flagpole, but including a boathouse, which projects above high water or ground elevation, more than five feet.

Swash - non-breaking waves which travel up the shore.

Swimline - a line which delineates a swimming area and within which boats are prohibited.

Tributyltins - toxic substances which are added to paints to prevent the growth of algae. They may leach from boat hulls and accumulate in lake bottom material.

Turbidity - a measure of reflected light from sediments or other matter suspended in the water. In general, the more matter in the water, the more reflection there is, and, therefore, the higher the turbidity.

VMT - a vehicle mile of travel.

Wave run-up - that area in the backshore extending from the point where waves first break on the sand to the point that marks their "run-up" onto the sand.

Wood pilings - large logs or timbers which are driven vertically into a lake bottom.

Appendix A
FEBRUARY 26, 1997 ACTION ON MOTORIZED WATERCRAFT - MARCH 26, 1997 RESOLUTION

TRPA Governing Board Action
2/26/97

MOTORIZED WATERCRAFT IMPACT ANALYSIS

The Governing Board directed TRPA staff to:

Actions to be taken at the March Governing Board meeting.

1. Draft a resolution requesting assistance from California Environmental Protection Agency (Cal EPA), Lahontan Water Quality Control Board, Nevada Department of Environmental Protection (NDEP) and Environmental Protection Agency (EPA) to help resolve issues related to motorized watercraft and MTBE.

2. Prepare a report on the feasibility of implementing a boating registration program and an inspection and maintenance program.

Actions to be taken at the June Governing Board meeting.

Direct staff to prepare the necessary findings, environmental documents, and ordinances for presentation at the June 1997 Governing Board meeting. This should include the following:

1. In response to the unburned fuel impacts – Draft an ordinance to be adopted that will phase out the use of carbureted two-stroke engines in the Basin effective June 1, 1999. This ban may be modified with an ordinance amendment if further scientific data indicates a more or less restrictive measure is appropriate.

2. In response to noise impacts, water quality impacts, recreation conflicts, boating safety impacts, and wildlife impacts – Draft an ordinance that establishes a no wake zone (speed limit) for all watercraft that is sufficient to allow people on the beach to have a normal conversation at four to six feet (PSIL concept), sufficient to prevent recreational conflicts between beach users, swimmers, fishermen, and watercraft, sufficient to provide for increased boating safety in congested areas, sufficient to protect fish habitat and water intakes, and sufficient to protect shorezone wildlife.

3. In response to fishery and wildlife impacts – Draft an ordinance that bans use of motorized watercraft within tributaries of Lake Tahoe.

Impacts and Mitigation to be Resolved with the Shorezone Consensus Process.

1. In response to the impacts identified for all motorized watercraft – Direct TRPA staff and the Shorezone Consensus Group to consider standards and programs to mitigate the watercraft impacts identified at the February Governing Board meeting. This will include:

    a) An Inspection and Maintenance program for all motorized watercraft.

    b) An air quality mitigation fee focused on NO_x.

    c) A limitation on the number of motorized watercraft permitted on the Lake.

    d) A program to require the use of bilge sponges.

    e) A program to implement shorezone BMPs and other mitigation on existing uses related to motorized watercraft use.

    f) Establishing of more restrictive noise standards for individual watercraft and special area performance standards.

    g) Establishing of limits on the hours of operation for concessionaires who rent watercraft with two-stroke engines.

    h) Establishing a limit on the number of commercial watercraft until the regulations are adopted.

    i) Establishing a boating registration program.

To be included in the 97/98 TRPA Work Program.

1. In response to the need to inform the public and to promote an orderly implementation of the mitigation measures over the next two years – Direct staff to include an educational program, a MOU program to establish enforcement program and possible use of TRPA mitigation fees, and a signage program.

2. In response to the need for coordination – Direct the Local Government Committee and staff to work with state and local agencies to implement the mitigation measures.

Appendix B
LAKE TAHOE MOTORIZED WATERCRAFT REPORT – AN INTEGRATION OF WATER QUALITY, WATER-CRAFT USE AND ECOTOXICOLOGY ISSUES (1998)

Refer to Report mailed in December, 1998